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MIL-STD-1660 TEST

on

REVISED METAL VOLCANO PALLET

AND TOP ADAPTER

Distribution Limited

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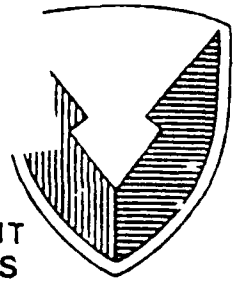

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The U.S. Army Defense Ammunition Center and School (USADACS), Evaluation Division (SMCAC-DEV), was tasked by the U.S. Army Armament Research, Development and Engineering Center (ARDEC), SMCAR-ESK, Rock Island, IL to test the revised Volcano pallet and pallet adapter. This report contains the procedures, results, and recommendations from the MIL-STD-1660 tests conducted. As tested, the revised Volcano pallet and pallet adapter successfully passed MIL-STD-1660, Design Criteria for Ammunition Unit Loads, with the understanding that an Engineering Change Proposal (ECP) will be initiated to increase the stacking lug strength.

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Savanna, IL 61074-9639

REPORT NO. EVT 15-90

MIL-STD-1660 TESTS

ON

REVISED METAL VOLCANO PALLET AND PALLET ADAPTER

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PART 1

INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center and School, Evaluation Division, was tasked by ARDEC, SMCAR-ESK, to test the revised metal Volcano pallet and pallet adapter.

B. AUTHORITY. This test was conducted in accordance with mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Rock Island, IL.

C. OBJECTIVE. The objective of this series of tests was to assess the ability of the revised metal Volcano pallet and pallet adapter to sustain transportation conditions.

PART 2

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PART 3

TEST PROCEDURES

The test procedures outlined in this section were extracted from MIL-STD-1660, Design Criteria for Ammunition Unit Loads, 8 April 1977. This standard identifies nine steps that a unitized load must undergo if it is considered to be acceptable. The five tests that were conducted on the test pallet are synopsized below.

A. STACKING TESTS. The unit load shall be loaded to simulate a stack of identical unit loads stacked 16 feet high, for a period of one hour. This stacking load is simulated by subjecting the unit load to a compression of weight equal to an equivalent 16-foot stacking height. The compression load is calculated in the following manner. The unit load weight is divided by the unit load height in inches and multiplied by 192. The resulting number is the equivalent compressive force of a 16-foot-high load.

B. REPETITIVE SHOCK TEST. The repetitive shock test shall be conducted in accordance with Method 5019, Federal Standard 101. The test procedure is as follows: The test specimen shall be placed on, but not fastened to, the platform. With the specimen in one position, vibrate the platform at 1/2-inch amplitude (1-inch double amplitude) starting at a frequency of about 3 cycles per second. Steadily increase the frequency until the package leaves the platform. The resonant frequency is achieved when a 1/16-inch-thick feeler gage may be momentarily slid freely between every point on the specimen in contact with the platform at some instance during the cycle or a platform acceleration achieves 1 $\pm$ 0.1 G. Midway into the testing period the specimen shall be rotated 90 degrees and the test continued for the duration. Unless failure occurs, the total time of vibration shall be two hours when the

specimen is tested in one position. When the specimen is tested in more than one position, the total time shall be three hours.

C. EDGEWISE ROTATIONAL DROP TEST. This test shall be conducted by using the procedures of Method 5008, Federal Standard 101. The procedure for the Edgewise Rotational Drop Test is as follows: The specimen shall be placed on its skids with one end of the pallet supported on a beam 4 1/2 inches high. The height of the beam shall be increased if necessary to ensure that there will be no support for the skids between the ends of the pallet when dropping takes place, but should not be high enough to cause the pallet to slide on the supports when the dropped end is raised for the drops. The unsupported end of the pallet shall then be raised and allowed to fall freely to the concrete, pavement, or similar underlying surface from a prescribed height. Unless otherwise specified, the height of drop for level A protection shall conform to the following tabulation.

GROSS WEIGHT NOT EXCEEDING	DIMENSIONS ON ANY EDGE NOT EXCEEDING	HEIGHT OF DROP LEVEL A PROTECTION
60[illegible] lbs.	72 inches	36 inches
3,000 lbs.	no limit	24 inches
no limit	no limit	12 inches

4. IMPACT TEST. This test shall be conducted by using the procedure of Method 5023, Incline-Impact Test of Federal Standard 101. The procedure for the Incline-Impact Test is as follows: The specimen shall be placed on the carriage with the surface or edge which is to be impacted projecting at least two inches beyond the front end of the carriage. The carriage shall be brought to a predetermined position on the incline and released. If it is desired to concentrate the impact on any particular position on the container, a 4- by 4-inch timber may be attached to the bumper in the desired position before the test. No part of the timber shall be struck by the carriage. The

position of the container on the carriage and the sequence in which surfaces and edges are subjected to impacts may be at the option of the testing activity and will depend upon the objective of the tests. When the test is to determine satisfactory requirements for a container or pack, and, unless otherwise specified, the specimen shall be subjected to one impact on each surface that has each dimension less than 9.5 feet. Unless otherwise specified, the velocity at time of impact shall be 7 feet per second.

5. SLING COMPATABILITY TEST. Unit loads utilizing special design for nonstandard pallets shall be lifted, slung, lowered, and otherwise handled as necessary using slings of the types normally used for handling the unit loads under consideration. Slings shall be easily attached and removed. Danger of slippage or disengagement when load is suspended shall be cause for rejection of the unit load.

PART 4

TEST EQUIPMENT

A. TEST PALLET.

1. Drawing Number:	AC200000414
2. Unitization:	5 high X 4 wide
3. Width:	28-13/16 inches (73.2cm)
4. Length:	59 inches (149.9cm)
5. Height:	41 1/4 inches (104.8cm)
6. Weight:	2,280 pounds (1,036kg)

B. COMPRESSION TESTER.

1. Manufacturer:	Ormond Manufacturing
2. Platform:	60 inches by 60 inches
3. Compression Limit:	50,000 pounds
4. Tension Limit:	50,000 pounds

C. TRANSPORTATION SIMULATOR.

1. Manufacturer:	Gaynes Laboratory
2. Capacity:	6,000 pound pallet
3. Displacement:	1/2-inch Amplitude
4. Speed:	50 to 400 rpm
5. Platform:	5-foot by 8-foot

D. INCLINED RAMP.

1. Manufacturer:	Conbur Incline
2. Type:	Impact Tester
3. Grade:	10 percent Incline
4. Length:	12-foot Incline

PART 5

TEST RESULTS

A. MIL-STD 1660 TESTS

Prior to testing, the pallet was unitized per requirements. Although, during the assembly of the pallet adapter to pallet, one of the stacking lugs fractured. This lug was replaced before testing. Also, the pallet was found to be susceptible to tipping, so the tip over test was added. Additional justification for the tip over test was to separate the modes of impact into tip over and edgewise, to better determine a cause of failure.

1. Stacking Test.

The first test pallet was loaded to 10,600 pounds compression for a period of one hour. During and after the test no damage was noted.

2. Repetitive Shock Test.

During the first 90-minute cycle of vibration the pallet skids were longitudinal to the induced dynamic load. The test equipment during this cycle was operated at 210 revolutions per minute (rpm) which achieved the required 1/16-inch minimum clearance. The second 90-minute cycle of vibration was at 115 rpm with the pallet skids oriented lateral to the induced dynamic load. At the end of testing a 1/2-inch crack was noted at points of contact with the skid supports and pallet deck. No other damage was noted.

3. Tip Over Test.

The pallet tipped over when either the left or right side was raised 24 inches due to the high center of gravity. Therefore, the tip over test was done only on the two sides. No damage was noted during the tip over test.

4. Edgewise Rotational Drop Test.

The unitized load was drop tested on the front and rear edges from a height of 24 inches per MIL-STD 1660 specifications. Since the pallet is

susceptible to tipping, the sides were only dropped from 18 inches instead of 24 inches. During the side drops, the pallet had enough momentum to tip over, thus repeating the tip over test. One of the four stacking lugs failed at the narrower base during the rotational drop test, but the other three remained intact during the remaining tests. The lug failed due to shear when the unitized load tipped over on its side during a drop.

5. Impact Test.

The incline plane was set to allow the pallet to travel 8 feet prior to impacting a stationary wall. The pallet was rotated clockwise after each impact until all four sides had been tested. No damage was noted to the pallet or top pallet adapter assembly during this test.

6. Sling Compatibility Test.

The sling test consisted of four different lifting configurations using the top adapter assembly and a four-legged sling. The sling configurations included a three corner, two alternate corners, two adjacent corners, and a single corner lift. No damage to the pallet or lifting rings were noted during the lifts.

7. Disassembly.

The test specimen was disassembled following the tests and another stacking lug was accidentally broken, again, at the narrower base.

PART 6

CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS. The revised metal Volcano pallet and pallet adapter passed MIL-STD-1660, Design Criteria for Ammunition Unit Loads. The pallet remained intact in spite of the damage sustained from the testing. The fragility of the stacking lugs is cause for concern. Since the pallet tipped over during the edgewise drop test, the cause of failure of the lugs is indeterminate. However, since a lug failed during assembly and disassembly, the cause for concern is still apparent. Recommendations given below would reduce the chances of stacking lug failure on production pallets.

B. RECOMMENDATIONS. Stacking lug failure has been an ongoing problem in past projects. To avoid failure of stacking lugs, material strength and/or diameter of the lugs at the base should be increased. Note this problem was previously identified during MIL-STD 1660 Test of PA116, EVT-47-87-2. The metal Volcano pallet and pallet adapter passed MIL-STD-1660. An ECP should be initiated to increase the stacking lug strength for the Volcano pallet as well as other metal pallets.